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VIMAR CORPORATION
BOULDER, COLORADO

NIOSH INVESTIGATOR:
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I. SUMMARY

In November, 1985, the National Institute for Occupational Safety and Health (NIOSH) was requested to evaluate cyanide exposures to employees who perform color brightening for jewelry. The company has recently begun color brightening jewelry with a new bombing technique and was concerned about potential health hazards associated with the process.

On December 17, 1985, an environmental survey was performed in the jewelry brightening department at Vimar Corporation. Seven air samples, one personal breathing zone, and six area samples were collected to measure airborne concentrations of cyanide. Sampling times were approximately 60 to 75 minutes. Wipe samples were collected inside the glove box to characterize the amount of cyanide contamination in the chamber before and after the brightening procedure. Additional wipe samples were also collected at locations outside the brightening chamber.

Personal breathing zone and area air samples taken for cyanide (range 0.003 - 0.004 mg/M^3) were all less than the OSHA Time-Weighted Average Standard (TWA) and the ACGIH TWA criteria of 5 mg/M^3. The NIOSH criteria is 5 mg/M^3 for a 10-minute period. The wipe samples taken inside the chamber before the brightening process ranged from 0.01 to 16.0 ug versus 0.6 to 56.0 ug after the process. Wipe samples around the work area, ranged from 0.02 - 32.0 ug. The surface area for each wipe sample was approximately 50 square inches.

On the basis of the air monitoring results, it was concluded that a health hazard did not exist from airborne cyanide exposure during the study period. It was determined that residual cyanide was present inside and outside the glove box, and therefore, contamination through the skin is possible. Recommendations for reducing potential exposure from cyanide are included in this report.

KEYWORDS: SIC 3911 (Jewelry, Silverware, and Plated Ware) cyanide, color brightening.

II. INTRODUCTION

The National Institute for Occupational Safety and Health (NIOSH) received a request in November, 1985, from a representative of Vimar Corporation, Boulder, Colorado. The request was submitted by management their primary concern was the potential occupational health hazards associated with cyanide used during a brightening process for jewelry. Air monitoring and wipe samples were taken in and around the glove box where the brightening process is performed.

The results of the evaluation were presented to the requestor as they became available. Recommendations to reduce potential exposures were given to management during the survey and these are included in this report.

III. BACKGROUND

Vimar Corporation, Boulder, Colorado is a jewelry manufacturing company. It has been in business for over five years and the company has grown from a few employees to approximately twenty. With the increased production, the company has continually improved on the quality of its jewelry making process. In 1985, Vimar purchased a glove box exhaust system to improve on the safequards to the employees during the jewelry brightening/bombing process. During this procedure, sodium cyanide and hydrogen peroxide interact to etch the jewelry and literally bomb the surface of the material, thus providing a brighter finish.

Normally, this procedure is performed on a work bench with no ventilation and other controls to eliminate exposures. The procedure is called bombing because of the explosive actions that take place. This solution is very unstable and the results are often very mixed. In cases where the chemical action is allowed to go too far or the proper mixture has not been made, the solution may explode from the container, posing a safety threat to the operator.

With the addition of the bombing chamber, the hazard to the employee is now greatly reduced. The employee is required to wear latex rubber gloves and an apron to remove the cyanide from storage; while transporting the material to the glove box chamber and while measuring the cyanide prior to the brightening procedure. Once the chemicals are inside the chamber, the cabinet sash is closed and the chemical mixing begins. After the bombing procedure is complete, the jewelry is rinsed repeatedly and removed. As a final precaution, all suspected equipment and/or materials both in and outside the chamber are rinsed and/or submerged in a water/chlorine solution (PH:10.5) to neutralize any residual cyanide. The cyanide/bombing room is locked when not in use to eliminate unforseen hazards.

Besides the personal protective clothing described above, the gloves in the chamber are inspected daily for damage. The glove box exhaust system is rated at 1200 cubic feet per minute. The make up air flow rates obtained in the slots on the side of the chamber both ranged from 1200 to 1800 feet per minute with the sash closed.

IV. SAMPLING DESIGN AND METHODS

Seven air samples, one personal, and six general area samples for cyanide were collected during the jewelry brightening procedure. These samples were collected by drawing air through cellulose ester membrane filters at a flow rate of 1.5 liters per minute over a sampling period of 60-75 minutes. Similar membrane paper was also used during the wipe sampling. The surface area for each wipe sample was approximately 50 square inches (2 inches by 2 feet).

Each of the air and wipe samples were analyzed using NIOSH Method S-250, modified by use of the Technician Auto-Analyzer for detection.

An evaluation of the personal protective clothing, work process and exhaust ventilation system was also conducted during the survey.

V. EVALUATION CRITERIA

A. Environmental

As a guide to the evaluation of the hazards posed by workplace exposures, NIOSH field staff employ environmental evaluation criteria for assessment of a number of chemical and physical agents. These criteria are intended to suggest levels of exposure to which most workers may be exposed up to 10 hours per day, 40 hours per week for a working lifetime without experiencing adverse health effects. It is, however, important to note that not all workers will be protected from adverse health effects if their exposures are maintained below these levels. A small percentage may experience adverse health effects because of individual susceptibility, a pre-existing medical condition, and/or a hypersensitivity (allergy).

In addition, some hazardous substances may act in combination with other workplace exposures, the general environment, or with medications or personal habits of the worker to produce health effects even if the occupational exposures are controlled at the level set by the evaluation criterion. These combined effects are often not considered in the evaluation criteria. Also, some substances are absorbed by direct contact with the skin and mucous membranes, and thus potentially increase the overall exposure. Finally, evaluation criteria may change over the years as new information on the toxic effects of an agent become available.

The primary sources of environmental evaluation criteria for the workplace are: 1) NIOSH Criteria Documents and recommendations, 2) the American Conference of Governmental Industrial Hygienists' (ACGIH) Threshold Limit Values (TLV's), and 3) the U.S. Department of Labor (OSHA) occupational health standards. Often, the NIOSH recommendations and ACGIH TLV's are lower than the corresponding OSHA standards. Both NIOSH recommendations and ACGIH TLV's usually are based on more recent information than are the OSHA standards. The OSHA standards also may be required to take into account the feasibility of controlling exposures in various industries where the agents are used; the NIOSH-recommended exposure limits, by contrast, are based primarily on concerns relating to the prevention of occupational disease. In evaluating the exposure levels and the recommendations for reducing these levels found in this report, it should be noted that industry is legally required to meet those levels specified by an OSHA standard.

A time-weighted average (TWA) exposure refers to the average airborne concentration of a substance during a normal 8- to 10-hour workday. Some substances have recommended short-term exposure limits or ceiling values which are intended to supplement the TWA where there are recognized toxic effects from high short-term exposures. The current criteria and/or standards for cyanide are as follows:

	Environmental Exposure Limits 8-Hour Time-Weighted Average (TWA) and for short term exposures	
Cyanide	OSHA	5.0 mg/M^3
	NIOSH	5.0 mg/M^3 10 min. ceiling
	ACGIH	5.0 mg/M^3 (skin)

mg/M^3 = milligrams of substance per cubic meter of air
ACGIH = Skin refers to the potential contribution to the overall exposure by the cutaneous route.

B. Toxicology

Cyanide is well known as an acute, fast acting poison. It can be described as insidious in that its toxic action at high concentrations is so rapid that its odor has no value as a warning. At lower concentrations, the sense of smell may provide forewarning. The primary routes of entry from occupational exposure are inhalation and absorption through the skin. Absorption by either route is rapid. At low levels cyanide can produce weakness, headaches, confusion, nausea, respiratory, eye, and skin irritation. At higher levels it can cause asphyxia and death. Organs affected include the cardiovascular and central nervous systems, liver, kidney, and skin.

The American Conference of Governmental Industrial Hygienists have placed a SKIN notation on cyanide. This refers to the potential contribution to the overall exposure by the cutaneous route. This includes exposure via mucous membranes and eye, either by the airborne route, or more particularly, by direct contact with the substance.

VI. RESULTS AND CONCLUSIONS

Air monitoring results taken during the survey did not confirm the presence of cyanide at levels that would present a health hazard (levels of cyanide ranged from 0.003 to 0.004 mg/M^3.. Wipe samples taken in and around the work area suggest the possibility of an exposure. The potential for an exposure by either inhalation and/or skin absorption was likely prior to the glove box technique now being used. This is especially true due to the unpredictable reaction which can take place during the mixing/bombing process.

Based on the environmental air samples taken during the investigation the potential for over-exposures does not exist. This was thought to be due primarily to the new engineering exhaust system installed. Therefore, all future work with cyanide should continue to be performed in this exhaust system. Based on the wipe samples, it is also believed that the possibility of exposure through the skin can be resolved through good housekeeping techniques.

VII. RECOMMENDATIONS

The following recommendations are provided to assist in the reduction and elimination of exposures to the employees.

1. A review of the ventilation system should be performed annually or as necessary.

2. Personal protective clothing should be provided to the employees if they are required to perform any maintenance activities (e.g. cleaning, repairs, etc.) where the cyanide is stored and used. This should include protective gloves, aprons, and respirators. Respirators should be approved by NIOSH/MSHA and be specific for use with cyanide.

3. Safety goggles and faceshields to protect eyes from crystals and direct splashing are also recommended.

4. An eyewash station and safety shower should be immediately accessible to workers where cyanide is used or handled. Washing facilities and water should be available for emergency use.

5. If eye contact occurs, the eyes should be flushed with running water immediately and this procedure continued for at least 15 minutes, including under the eye lids. One should contact a physician immediately.

6. Vimar should store sodium cyanide in a dry, well-ventilated area and not store it with acids or weak alkalies.

7. Do not eat, drink, or smoke in areas where cyanide is present. Do not handle or store food or beverages in cyanide areas.

8. First aid kits should be available. They should contain a minimum of 48 (samples), each of 0.3 ml amyl nitrate. These should be replaced biannually to ensure their potency.

VIII. REFERENCES

1. NIOSH Pocket Guide to Chemical Hazards, DHEW (NIOSH) Publication No. 85-114.

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6. Proctor, N.H. and Hughes, J.P., Chemical Hazards of the Workplace, J.P. Lippincott Company, Philadelphia, 1978, pp. 112-113.

7. Criteria for a Recommended Standard. Occupational Exposures to Hydrogen Cyanide and Cyanide Salts, U.S. Department of Health, Education, and Welfare, DHHS/CDC/NIOSH.

IX. AUTHORSHIP AND ACKNOWLEDGMENTS

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X. DISTRIBUTION AND AVAILABILITY

Copies of this report are currently available upon request from NIOSH, Division of Standards Development and Technology Transfer, Information Resources and Dissemination Section, 4676 Columbia Parkway, Cincinnati, Ohio 45226. After 90 days the report will be available through the National Technical Information Service (NTIS), Springfield, Virginia. Information regarding its availability through NTIS can be obtained from NIOSH, Publications Office, at the Cincinnati address.

Copies of this report have been sent to:

1. Vimar Corporation, Boulder, Colorado
2. U.S. Department of Labor/OSHA - Region VIII.
3. NIOSH - Denver Region.
4. Colorado State Health Department
5. State Designated Agency.

For the purpose of informing affected employees, a copy of this report shall be posted in a prominent place accessible to the employees for a period of 30 calendar days.

TABLE 1

BREATHING ZONE AND AREA AIR CONCENTRATIONS
FOR CYANIDE
Vimar Corporation
Boulder, Colorado
December, 1985

AREA/JOB DESCRIPTION	SAMPLING TIME (MINUTES)	mg/M^3 CYANIDE
Personal	75	0.003
Mixing Cabinet	75	0.004
Glove Box - Outside left	60	0.004
Glove Box - Outside right	60	0.004
Glove Box - Inside left	60	0.004
Glove Box - Inside right	60	0.004
Glove Box - Exhaust pipe	60	0.004

EVALUATION CRITERIA: (mg/M^3)	OSHA	5.0 (TWA)
	ACGIH	
	NIOSH	5.0 (10 minutes)
LABORATORY LIMIT OF DETECTION: (ug/sample)		0.01 ug/ML

mg/M^3 = milligrams of substance per cubic meter of air.
ug/sample = micrograms per sample.
TWA = Time Weighted Average
ug/ML = Micrograms per milliliter

TABLE 2

CYANIDE WIPE SAMPLES
Vimar Corporation
Boulder, Colorado
December, 1985

AREA/JOB DESCRIPTION	ug/sample CYANIDE
<u>Pre-Brightening Process</u>	
Glove Box - Inside/bottom	0.03
Glove Box - Inside/center	0.05
Glove Box - Inside/top	16.0
Residual rinse - chamber wash	0.01
<u>Post Brightening Process</u>	
Glove Box - Inside/bottom	0.06
Glove Box - Inside/center	40.0
Glove Box - Inside/top	56.0
<u>Additional Wipe Samples</u>	
Glove box air vents	0.05
Exterior gloves (inside glove box)	0.02
Exterior gloves (outside glove box)	0.57
Inside cyanide storage cabinet	0.5
Top of cyanide scales	32.0
Mixing gloves	4.6

ug/sample = Micrograms per sample